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DIFFERENTIATION OF F(X) = LOG (X).

BY PROF. JAMES G. CLARK, LIBERTY, MO.

THE characteristic property of this function is expressed by the equation

$$F(x^m) = mF(x),$$

from which we have at once

$$dF(x^m) = mdF(x).$$

Let us assume $dF(x) = f(x)dx$, in which $f(x)$ is an unknown function. We have then

$$dF(x^m) = f(x^m)dx^m = mx^{m-1}f(x^m)dx.$$

Therefore by substitution,

$$mx^{m-1}f(x^m)dx = mf(x)dx, \text{ and}$$

$$f(x^m) = \frac{f(x)}{x^{m-1}}, \text{ or } x^m f(x^m) = xf(x).$$

This relation being independent of the value of m, it follows that

$$xf(x) = M, \text{ a constant.}$$

Therefore $f(x) = \frac{M}{x}$, and $dF(x) = d\log(x) = \frac{M}{x}dx$.

In this equation M is of unknown value. Its value cannot be directly determined from the general properties of logarithms, but it may be observ'd that in whatever system the logarithms be taken, $\log x \div M$ will be the logarithm of x in some other system, whose base may be denoted by e. W have, therefore, from the equation

$$d\log(x) = \frac{M}{x}dx,$$

$$d\left\{\frac{\log x}{M}\right\} = d\log_e x = \frac{dx}{x}.$$

There is therefore one system for which the multiplier of $dx \div x$ is unity, and it readily follows that the multipliers of $dx \div x$ in different systems are proportional to their moduli. It may be shown in the usual way by Maclaurin's theorem that $e =$ Napierian base.

SOLUTIONS OF PROBLEMS IN NUMBER ONE.

SOLUTIONS of problems in No. 1 have been received as follows:

From Marcus Baker, 423, 426; Florian Cajori, 423, 424, 425, 426, 427; George E. Curtis, 423; Prof. W. P. Casey, 423, 426; G. W. Evans, 423;